ITEM: 13

SUBJECT: United States Air Force Beale Air Force Base, Site 10 Enhanced Bioremediation Pilot Study, Yuba County

BOARD ACTION: *Consideration of New Waste Discharge Requirements.*

BACKGROUND: The United States Air Force (Air Force) operates Beale Air Force Base (hereafter Discharger) located in Yuba County approximately 40 miles north of Sacramento and 10 miles east of Marysville. Site 10, the location of the enhanced in-situ bioremediation (EISB) pilot study is located in the north-central portion of Beale AFB, east of Doolittle Drive and the Flight line. Contaminants of Concern (COCs) identified at Site 10 in groundwater include volatile organic compounds (VOCs) and Total Petroleum Hydrocarbons, Diesel Range (TPH-D). VOCs detected in the pilot test area include the following constituents: PCE (43 µg/l), TCE (1310 µg/l) and cis-1,2 DCE (2020 µg/l).

The Air Force proposes to conduct a pilot test to evaluate whether sodium lactate has the ability to enhance reductive dechlorination of VOCs in the upper groundwater zone by native microorganisms and the potential for bioaugmentation to accelerate the rate and extent of biodegradation of VOCs.

The EISB pilot project is a recirculation system, which extracts groundwater from one well, amends the groundwater with electron donor (lactate) and bacteria, and reinjects the amended water in an upgradient location of the aquifer.

Baseline concentrations will be determined for VOCs and other constituents in monitoring wells downgradient and within the pilot test area. If concentrations of breakdown compounds of TCE increase above baseline concentrations in extraction well 10C024EW, the Discharger would be required to evaluate whether adequate treatment of VOCs in the pilot test area is occurring by collecting additional confirmation samples from several downgradient wells. If an exceedance of baseline conditions is confirmed in these downgradient wells, and it is determined that the EISB system is not providing adequate treatment of VOCs in the pilot test area, the Discharger would be required to implement containment measures for VOCs migrating outside of the pilot test area.

ISSUES: The Discharger provided comments on the Tentative Waste Discharge Requirements (Draft Order) on 23 February 2004 and verbal comments on 27 February 2004. Staff met with the Discharger on 23 February 2004 and discussed initial

comments. Several comments that were provided on the 23 and 27 February 2004 were not resolved and it is Board staffs understanding that the Discharger is contesting this Draft Order for the following reasons:

a) The Discharger believes it should have input when baseline concentrations for VOCs and other constituents described in the Monitoring and Reporting Program (MRP) are established for groundwater.

   The Discharger disagrees that the monitoring requirements would provide sufficient flexibility for evaluating whether the EISB system is operating adequately. Board staff believe that the monitoring requirements outlined in the MRP and other reporting requirements listed in the Draft Order (i.e. Baseline Summary Report and Pilot Test Implementation Report) provide the Discharger opportunity to collect data and provide evaluations that support whether the EISB system is functioning properly and, which design and operational factors influence the performance of the EISB system.

b) The Draft Order does not allow the Discharger to provide input in making the determination that the Pilot Test System is providing adequate treatment of groundwater pollution inside the pilot test area and the area extending downgradient to the compliance monitoring wells.

   The Draft Order requires that the Discharger provide additional containment measures downgradient of the EISB system if monitoring data suggest that adequate treatment of VOCs is not occurring in the pilot test area. Adequate treatment is measured by complete biodegradation of TCE and its daughter products. If this does not occur some daughter products, which in some cases have lower water quality objectives, could potentially degrade groundwater downgradient of the pilot test area

c) The Discharger believes it should not be subject to implementing containment measures that include a compliance schedule as outlined in the Draft Order. It is the Dischargers position that the selection of a treatment technology and an implementation schedule (subject to the dischargers input and funding) should only be conducted after it has been determined by the Discharger and the Regional Board that additional containment measures are necessary.

The provision to require a contingency plan, which includes the requirement to provide containment measures downgradient of the pilot test area, is necessary to assure that further degradation of the aquifer does not occur and is also necessary to assure that cleanup of the aquifer is not prolonged. Also, the Draft Order lists several conditions, which discharger must meet to assure compliance with Resolution 68-16 (Anti-Degradation Policy). Degradation of the aquifer downgradient of the pilot test area could potentially degrade the aquifer with TCE daughter products that differ from those observed prior to baseline conditions. If an evaluation of this data suggests that the detection of these constituents is not a temporal condition and instead suggests that the EISB system is not providing adequate treatment of VOCs in the pilot test area (i.e. groundwater pollutants exceed baseline concentrations), this condition would be unacceptable and would require cleanup activities in addition to the scope of the pilot project Additional measures outlined in a contingency plan are necessary to assure that groundwater quality is protected beyond the pilot test area.

Mgmt. Review _____
Legal Review _____

18 and 19 March 2004, Region 5 Board Meeting

CVRWQCB
11020 Sun Center Drive, No. 200
Rancho Cordova, CA 95670

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. R5-2004-XXX

WASTE DISCHARGE REQUIREMENTS
FOR
UNITED STATES AIR FORCE
BEALE AIR FORCE BASE, SITE 10
ENHANCED BIOREMEDIATION PILOT STUDY
YUBA COUNTY

The California Regional Water Quality Control Board, Central Valley Region (hereafter Regional Board), finds that:

1. The United States Air Force (hereafter Discharger), submitted a Draft Sampling and Analysis Plan (Draft SAP) for Beale Air Force Base Sites 10 and 13 on 15 September 2003. The Draft SAP, submitted by Beale Air Force Base, included plans for conducting a bioremediation pilot project to evaluate the potential for in-situ treatment of groundwater containing trichloroethylene (TCE) within the Site 10 investigation area (hereafter referred to as Site). The Site location on Section 16, T5E, R15N, MDB&M, is shown on Attachment A, which is attached hereto and made part of this Order by reference. The Discharger will be constructing and operating the pilot project on land the Discharger owns. The Site is located in the north-central portion of Beale AFB, east of Dolittle Drive and the Flight line Area. A portion of the Site consists of a paved area at the eastern end of Grumman Avenue.

2. The Site 10 investigation area and underlying groundwater contains TCE, PCE and cis-1,2-DCE. On-going groundwater monitoring activities at Site 10, which include a network of 23 monitor wells, have detected maximum concentrations of PCE at 43 µg/L, TCE at 1310 µg/L and cis-1,2-DCE at 2020 µg/L.

3. Investigations at Site 10 have determined two water bearing zones, an upper unconfined zone and a lower confined zone separated by a claystone layer. Groundwater samples from the upper and lower water bearing zones exhibit similar common ion signatures, suggesting that the two zones are fed from a common source. Most of the mass of chlorinated hydrocarbons (i.e. TCE) is in the upper water bearing zone, which is from 40 to 60 feet below ground surface.

4. The objectives of the pilot project are to demonstrate if an enhanced in-situ bioremediation (EISB) system has the ability to destroy TCE in situ through bioaugmentation. Other pilot test objectives include evaluating the impacts of EISB on overall groundwater chemistry, including mobilization of redox-sensitive metals or production of byproducts or biodegradation intermediates. Some other objectives of the study are to identify design and operational factors that influence

the performance of a field-scale EISB system, and optimizing, to the extent possible, operating conditions for field scale EISB systems.

5. The pilot test area, shown on Attachment B, which is attached hereto and made part of this Order by reference, will consist of an in-situ closed loop recirculation system to provide hydraulic control of added amendments. The system will include one injection well (10C0022IW) and one extraction well (10C024EW) approximately 36 feet downgradient of the injection well. Two monitoring wells were installed between the injection well and extraction well to facilitate estimation of biodegradation rates with the closed loop recirculation system. Electron donor addition is planned for a period of 4 to 5 months.

6. Performance of the closed loop system will be assessed by monitoring the decline of VOC concentrations coupled with the production of ethene and chloride in the recirculating groundwater and the monitoring wells, and the data will be used to estimate biodegradation rates and the effectiveness of the EISB technology for Site 10.

7. A tracer test was conducted using sodium bromide to estimate groundwater flow velocities and residence times under pumping conditions, estimate dispersion and dilution factors, estimate the percentage of mass capture by the recirculation system and, assess anticipated mass conservation and mass balance with the recirculation loop during the pilot test. This data confirmed that biostimulation amendments and products produced by the testing can be effectively contained by the pilot test system. Tracer testing was conducted using sodium bromide at a concentration of 100 mg/L by mixing 0.3 kilograms of sodium bromide with 3000 liters (792 gallons) of extracted groundwater. Groundwater monitoring will be conducted to evaluate sodium bromide concentrations within and downgradient of the pilot test area.

8. The bioremediation portion of the pilot test, which will follow the tracer testing, will be performed by pre-conditioning the pilot test area through an electron donor addition and by performing bioaugmentation to improve the rate and extent of TCE dechlorination to ethene. Pre-conditioning of the pilot test area will consist of the addition of organic acid sodium lactate. This pre-conditioning will occur for 2 to 4 weeks. After this initial phase, the pilot test area will be bioaugmented with the dehalorespiring microbial culture (KB-1 ™). KB-1 ™ is a proprietary non-pathogenic microbial community, which is an enrichment derived from naturally occurring bacteria found in soil and groundwater. Extensive testing of KB-1™, reported by the manufacturer SiREM, has shown absence of fecal related organisms making it unlikely that other fecal related diseases (viruses etc.) are present in this culture.

9. The KB-1 ™ culture will be delivered to the aquifer via injection well 10C022IW. Following bioaugmentation, the pilot test will be operated for 4 to 5 months. During this period, lactate will be added to reduce the potential for microbial fouling (once every other day). On the basis of electron donor demand calculations, a time-weighted average concentration of 138 mg/l sodium lactate (or 6 liters every other day) will be added. Approximately 21 liters of KB-1 will be added to the aquifer.

10. During the development of the Site 10 Sampling and Analysis Plan, a groundwater flow model was constructed. The computer model was used to evaluate the impacts of the planned recirculating bioremediation system on the regional flow field as well as to estimate travel time of amendment between the injection and extraction wells. This model was intended to be used for simple flow path analysis, rather than detailed hydrogeologic or solute transport analysis, and therefore did not undergo calibration. For the initial flow path analysis, an injection/extraction rate of 2.5 gpm was assigned to the bioremediation system wells. The model was run to steady-state using the heads generated by the January 2002 flow field as the initial condition. Using the model-generated flow field, 100 flow lines were started at the injection well and tracked forward for 4 months. The area covered by these flow lines represented the area that would potentially be impacted by the bioremediation system over the course of the pilot test (i.e. the 4-month recirculating flow field). Results indicate that a pumping rate of 2.5 gpm in well 10C024EW is sufficient to completely capture the area represented by the 4-month recirculating flow field. The model also indicates better capture can be accomplished by using an extraction rate of 1.0 gpm at wells 10C024EW and 10M004MW.

11. The Air Force intends to conduct monitored natural attenuation for the area downgradient of the VOC source zone at Site 10. These proposed cleanup activities and potential full-scale operation of the bioremediation system are documented in a Draft Record of Decision for Sites 10 and 13, dated 14 July 2003. Regional Board staff has requested the Air Force to evaluate the technical and economic feasibility of whether bioremediation of a larger area within the VOC source zone could be targeted (i.e. TCE concentrations less than 100 µg/L). Regional Board staff expect that findings from this pilot test will provide sufficient information to evaluate whether full-scale bioremediation could provide cleanup of a larger VOC source zone area than is currently documented in the Draft Record Decision for Sites 10 and 13. If necessary, Regional Board staff intends to revise and update these WDRs for full-scale bioremediation of a larger VOC source zone at Site 10.

12. If the concentrations of TCE exceed baseline concentrations in extraction well 10C024EW, a confirmation sample will be collected within 7 days of receiving

the results and the Discharger will notify Regional Board staff. If the exceedance of TCE is confirmed, the Discharger will sample monitor wells 10C002MW, 10L002MW and 10M006MW, which are located between 30 and 400 feet downgradient of the pilot study extraction wells and will sample for VOCs. Groundwater is estimated to move from 15 to 50 feet per year. Therefore, the soonest TCE and its breakdown products would be expected to reach these downgradient wells would be about 2 years following arrival of these constituents in the extraction well. The Discharger will sample the downgradient wells at three and six months after the sixth month sampling event in the extraction well. If breakdown products for TCE are detected in the downgradient wells above baseline concentrations and it has been determined that the EISB system is not providing adequate treatment of VOCs within the pilot test area, described in Finding 5, the Discharger will implement the Executive Officer's approved Contingency Plan to contain groundwater in the pilot test area and the downgradient area extending from the pilot test area to monitoring wells 10C002MW, 10L002MW and 10M006MW.

13. The injection into waters of the State is subject to regulation under the California Water Code. This Order authorizes the Discharger to inject sodium bromide tracer, sodium lactate and the KB-1 ™ culture.

14. This Order requires that the Discharger conduct groundwater monitoring as described in Monitoring and Reporting Program No. R5-2004-xxx . This monitoring is in addition to groundwater monitoring and analyses that is already being conducted by the Air Force with oversight by Board staff.

15. The *Water Quality Control Plan for the Sacramento and San Joaquin River Basins, Fourth Edition,* (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Resources Control Board. Pursuant to Section 13263 (a) of the California Water Code, waste discharge requirements must implement the Basin Plan.

16. Surface water drainage is to Hutchinson Creek, thence Western Pacific Interceptor, and thence the Bear River. The beneficial uses of the Bear River are municipal and domestic supply; agricultural supply; hydropower generation; water contact and non-contact water recreation; warm and cold freshwater habitat; migration of warm and cold freshwater organisms; spawning, reproduction, and/or early development of warm and cold freshwater organisms; and wildlife habitat.

17. The beneficial uses of underlying groundwater are agricultural supply, municipal and domestic supply, industrial service supply and industrial process supply.

18. State Water Resources Control Board (SWRCB) Resolution No. 68-16- "Statement of Policy with Respect to Maintaining High Quality Waters in California" (hereafter Resolution 68-16) requires the Board in regulating discharges to maintain high quality waters of the state (i.e., background water quality) until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in the Board's plans and policies (e.g. quality that exceeds any water quality objective). This discharge will consist of extracted groundwater amended with sodium lactate and bioaugmented with the dehalorespiring microbial culture KB-1 ™. Temporal degradation of groundwater at this site due to sodium lactate and/or KB-1 ™ injection may occur. The temporal degradation allowed by this Order is consistent with Resolution 68-16 since (1) the purpose is to accelerate and enhance remediation of unacceptable concentrations of several waste constituents and such remediation will benefit the people of the state; (2) the discharge facilitates a pilot project to evaluate the effectiveness of cleanup technology in accord with SWRCB Resolution 92-49 and is limited in scope and duration; (3) best practicable treatment, including adequate monitoring and contingency plans to assure protection of water quality, are required; and (4) the injection will not cause water quality objectives to be exceeded beyond the project target area or the duration of the project as specified in Findings 8 and 9. The recharge water will be of the same or better quality than the groundwater to which it is being recharged. The electron donor will be completely consumed in the process and VOC concentrations will be reduced. The Air Force plans on addressing remaining wastes in long-term actions that will be documented in the Final Record of Decision for Sites 10 and 13.

19. Section 13267 (b) of the California Water Code provides that: "In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste outside of its region that could affect the quality of the waters of the state within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the board requires. The burden, including costs of these reports, shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation

with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports."

The technical reports required by this Order and the attached MRP No. R5-2004-xxx is necessary to assure compliance with these waste discharge requirements. The Discharger operates the facility that discharges the waste subject to this Order.

20. Section 3020(b)(2) of the Resource Conservation and Recovery Act (RCRA) states that prior to injection into or above an underground source of drinking water, contaminated groundwater shall be "…treated to substantially reduce hazardous constituents prior to such injection." In a letter dated 10 December 1999, the United States Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER) states, "if extracted groundwater is amended at the surface (i.e., "treated") before reinjection, and the subsequent in-situ bioremediation achieves a substantial reduction of hazardous constituents the remedy would satisfy Section 3020(b)(2)." Therefore, the injection of groundwater within the treatment zone at this site, with or without the treatment for VOCs, complies with Section 3020(2)(b) of RCRA.

21. The California Department of Water Resources sets standards for the construction and destruction of groundwater wells, as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 74-81* (December 1981). These standards, and any more stringent standards adopted by the State or County pursuant to California Water Code Section 13801, apply to all monitoring wells.

22. Issuance of this Order is an action to assure the restoration of the environment and is, therefore, exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.), in accordance with Section 15308 and 15330, Title 14, California Code of Regulations (CCR).

23. This discharge is exempt from the requirements of *Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste,* as set forth in Title 27, CCR, Section 20005, et seq., (hereafter Title 27), which allows a conditional exemption from some or all of the provisions of Title 27. The exemption pursuant to Section 20090(b), is based on the following:

    a. The discharge constitutes action taken by or at the direction of public agencies (i.e., Regional Board and the Air Force),
    b. The discharge constitutes action to cleanup or abate conditions of pollution or nuisance resulting from unintentional or unauthorized releases of waste or pollutants to the environment, and

c. Wastes, pollutants, or contaminated materials will neither be removed from the immediate place of release for discharge elsewhere nor contained at the place of release, but will be treated in place.

24. Pursuant to California Water Code Section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.

25. All the above and the supplemental data and information and details in the attached Information Sheet, which is incorporated by reference herein, were considered in establishing the following conditions of discharge.

26. The Discharger and interested agencies and persons were notified of intent to prescribe waste discharge requirements for this discharge and provided with an opportunity for a public hearing and an opportunity to submit written views and recommendations.

27. In a public meeting, all comments pertaining to the discharger were heard and considered.

IT IS HEREBY ORDERED that pursuant to Sections 13263 and 13267 of the California Water Code, The United States Air Force, its agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following while conducting the above-described pilot study:

[Note: Other prohibitions, conditions, definitions, and some methods of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements" dated 1 March 1991, incorporated herein.]

A. Discharge Prohibitions

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.

2. The injection of other than citric acid and chlorine dioxide (for control of biofouling in wells); sodium bromide tracer; sodium lactate; and, the dehalorespiring microbial culture KB-1 ™ into groundwater is prohibited.

3. Discharge of waste classified as 'hazardous' under Section 2521 of Title 23, CCR, or as 'designated' under Section 13173 of California Water Code is prohibited.

4. Discharge of groundwater, lactate or the dehalorespiring microbial culture KB-1 ™ at a location or in a manner different from that described in Findings 4, 5, 6, 8 and 9 is prohibited.

B. Discharge Specifications

1. The Discharger shall provide hydraulic control within the treatment zone to prevent migration of groundwater pollutants, amendments, and breakdown products of the in situ treatment process during injection of any groundwater. The Discharger shall continue to provide hydraulic control while injection and cleanup are ongoing.

2. No waste constituent shall be released or discharged, or placed where it will be released or discharged, in a concentration or in a mass that causes violation of the Groundwater Limitations.

3. This Order allows injection of citric acid, chlorine dioxide, bromide tracer, sodium lactate and the dehalorespiring microbial culture KB-1 ™ under the conditions defined in Findings 5, 6, 7, 8 and 9. No other products shall be discharged.

4. The Discharger shall not cause the permeability of the aquifer, either inside or outside of the test cells, to be affected to such a degree that the Discharger is unable to effectively operate extraction wells for the purpose of containing the substrate and or its byproducts.

C. Groundwater Limitations

1. During the pilot study, the Discharger shall not cause an increase in amendments or byproducts including but not limited to sodium bromide tracer, sodium lactate and the dehalorespiring microbial culture KB-1 ™ above baseline concentrations in extraction well 10C02EW. Compliance shall be measured in downgradient wells 10C002MW, 10L002MW and 10M006MW

2. The Discharger shall not cause the groundwater to contain taste and odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

3. When the pilot study is completed, the amendments and byproducts shall not exceed baseline levels.

D. Provisions

1. The Discharger shall comply with the attached MRP No. R5-2004-XXX, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.

2. The Discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."

3. The Discharger shall notify Board staff a minimum of one week prior to the initial injection.

4. All of the following reports shall be submitted pursuant to Section 13267 of the California Water Code. All technical reports required herein that involve planning, investigation, evaluation, or design, or other work requiring interpretation and proper application of engineering or geologic sciences, shall be prepared by or under the direction of persons registered to practice in California pursuant to California Business and Professions Code sections 6735, 7835, and 7835.1. To demonstrate compliance with sections 415 and 3065 of Title 16, CCR, all technical reports must contain a statement of the qualifications of the responsible registered professional(s). As required by these laws, completed technical reports must bear the signature(s) and seal(s) of the registered professional(s) in a manner such that all work can be clearly attributed to the professional responsible for the work.

    a. The Discharger shall submit a Baseline Summary Report due no later than **60 days** after the collection of the third proposed sampling event to evaluate the natural variation and propose baseline numbers for the amendments and byproducts. The Baseline Report shall also include a Contingency Plan describing which containment measures will be conducted if the EISB system is not providing adequate treatment of VOCs within the pilot test area for Executive Officer's approval.

    b. The Discharger shall submit a Pilot Study Implementation Report due no later than **60 days** after startup of the enhanced bioremediation pilot study. The Pilot Study Implementation Report shall include a description

of the injection system and results of the first month of operation including analytical results.

c. If the Discharger proposes a second three-month injection period, the Discharger shall submit an Evaluation Report, which shall include analytical results to show the fate and transport of the initial sodium bromide tracer, sodium lactate and dehalorespiring microbial culture KB-1 ™ injection and proposed injection details including volume, rate, and concentration for the second injection. The Discharger shall not begin the second injection period before obtaining written Executive Officer approval.

d. The Discharger shall submit a Pilot Study Evaluation Report no later than **one year** after the final injection ends, which shall include a summary of analytical results, an evaluation of injection effectiveness, and discussion of feasibility for full-scale remediation.

5. If groundwater samples from any of the monitoring wells 10C002MW, 10L002MW or 10M006MW are above baseline concentrations for vinyl chloride, chloride, nitrate, nitrite, phosphate, sulfate, sulfide, dissolved iron or dissolved manganese, the Discharger shall immediately notify Regional Board staff of the exceedance(s) and obtain a confirmation sample within **7 days** of receiving the results. Within **48 hours** of receiving the confirmation sample results, the Discharger shall notify Regional Board staff of the results followed by written notification within **7 days**.

6. **Within 30 days** of confirming that baseline concentrations have been exceeded in monitoring wells 10C002MW, 10L002MW or 10M006MW, and it has been determined by the Executive Officer that the EISB system is not providing adequate treatment of VOCs within the pilot test area, the Discharger shall implement containment measures as described in the Executive Officer's approved Contingency Plan.

7. The Discharger shall comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Regional Board or court order requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.

8. The Discharger shall maintain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the sample, measurement, or report. This period may be extended during the

course of any unresolved litigation regarding this discharge or when requested by the Executive Officer.

9. The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control that are installed or used by the Discharger to achieve compliance with this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems, which are to be installed by the Discharger only when necessary to achieve compliance with the conditions of this Order.

10. The Discharger shall report any non-compliance, and/or accidental spill or release of liquid or material verbally to the Regional Board within 24 hours of the spill or release, and follow-up the verbal notification within 14 calendar days of the incident with written documentation of the spill or release, including remedial actions taken or proposed to contain and clean up the spill.

11. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

12. As described in the Standard Provisions, the Discharger shall report promptly to the Regional Board any material change or proposed change in the character, location, or volume of the discharge.

13. While this Order is in effect, and prior to any change in ownership of the site or management of this operation, the Discharger shall transmit a copy of this Order to the succeeding Owner/Operator, and forward a copy of the transmittal letter and proof of transmittal to the Board.

14. The Regional Board will review this Order periodically and will revise requirements when necessary.

I, THOMAS R. PINKOS, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 18 March 2004.

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THOMAS R. PINKOS, Executive Office

RRR

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. R5-2004-xxx
FOR
UNITED STATES AIR FORCE
BEALE AIR FORCE BASE
SITE 10
ENHANCED BIOREMEDIATION PILOT STUDY
YUBA COUNTY

This Monitoring and Reporting Program (MRP) incorporates requirements for monitoring the progress of the bioremediation pilot study. This MRP is issued pursuant to California Water Code Section 13267. The United States Air Force (Discharger) is required to comply with this MRP. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer

All samples shall be representative of the volume and the nature of the discharge and matrix of the sampled medium. The time, date, and location of each grab sample shall be recorded on the sample chain of custody form.

REMEDIATION PILOT STUDY MONITORING

A. LABORATORY PARAMETERS

Monitoring of the bioremediation pilot study shall consist of collecting groundwater samples from monitoring wells 10M004MW, 10C001MW, 10C023MW, 10C024EW and VEW-1 and shall follow the schedule below. Extraction well 10C024EW will be used to extract groundwater. Monitoring wells 10M004MW, 10C001MW and 10C023MW will be used to evaluate biodegradation rates in the pilot treatment area (PTA). Monitoring well samples shall be analyzed for the following constituents. These analyses shall be completed by a State certified laboratory and shall follow standard EPA protocol.

Constituents[1]	EPA Method	Maximum Quantitation Limit[2]	Frequency
Depth to Groundwater	---	0.01 ft	A
VOCs	SW8260B	0.5 µg/l	A
Field Parameters (pH, Dissolved Oxygen, oxidation-reduction potential, specific conductance and temperature	Field	Varies	C
Dissolved Hydrogen Gases (ethene,, ethane, and methane)	RSK-175	10 mg/l	A
Organic Acids (acetate, lactate, and propionate)	Ion Chromatography	1mg/l	A
Anions (chloride, nitrate, nitrite, phosphate, and sulfate)	SW9056	0.03 to 0.05 mg/l	B
Bromide	SW9056	0.05 mg/l	B

Table continued on the next page.

Constituents[1]	EPA Method	Maximum Quantitation Limit[2]	Frequency
Dissolved Iron and Manganese	SW6010	0.005 to 0.05 mg/l	B
Sulfide	SW9030	0.3 mg/l	B
DHE (Dehalococcoides ethenogenes)	PRC 16S rRNA	NA	B

2 For nondetectable results.
1 Baseline samples shall be collected a minimum of two weeks prior to injection.

A Weekly during pre-conditioning (2 to 4 weeks) and than PTA wells weekly (10M004MW, 10C023MW and 10C024EW) and all wells monthly (10M004MW, 10C001MW, 10C023MW, 10C024EW, and VEW-1) for 16 weeks during EISB
B Monthly for 4 months while injection is occurring and quarterly for 1 year after injection has ceased.
C Weekly for PTA wells
mg/l Milligrams per liter
µg/l Micrograms per liter
PTA pilot treatment area
EISB enhanced in situ bioremediation

B. FIELD MEASURED PARAMETERS

Monitoring of the bioremediation pilot study shall include field measured parameters recorded from downgradient well 10C001MW every time this well is sampled. The field measured parameters to be recorded are listed in the following table.

Constituents	Units
Electrical conductivity	µmhos/cm
pH	pH units
Oxidation-reduction potential	millivolts
Dissolved oxygen	mg/l
Temperature	ºF/ºC
Groundwater elevation	Feet and hundredths, mean sea level

Field testing instruments (such as those used to test oxidation-reduction potential and dissolved oxygen) may be used provided that:

1. The operator is trained in proper use and maintenance of the instruments;
2. The instruments are field calibrated prior to each monitoring event;
3. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency; and
4. Field calibration reports are provided with the appropriate monitoring report.

REPORTING

In reporting monitoring data, the Discharger shall arrange the data in tabular form so that the date, sample type (e.g., influent, effluent, groundwater, etc.), and reported analytical result for each sample are readily discernible. The data shall be summarized in such a manner to clearly illustrate compliance with waste discharge requirements and spatial or temporal trends, as

applicable. The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Reporting Program shall also be reported to the Regional Board. In addition, the Discharger shall notify the Board within 24 hours of any unscheduled shutdown of the enhanced bioremediation system.

As required by the California Business and Professions Code Sections 6735, 7835, and 7835.1, all Groundwater Monitoring Reports shall be prepared under the direct supervision of a Registered Engineer or Geologist and signed by the registered professional.

Quarterly reports shall be submitted to the Board by the **1st day of the second month following the end of each calendar quarter (i.e., by 1 February, 1 May, 1 August, and 1 November**). At a minimum, the reports shall include:

1. A narrative description of all preparatory, monitoring, sampling, and analytical testing activities for the groundwater monitoring. The narrative shall be sufficiently detailed to verify compliance with the WDR, this MRP, and the Standard Provisions and Reporting Requirements. The narrative shall be supported by field logs for each well documenting depth to groundwater; parameters measured before, during, and after purging; calculation of casing volume; total volume of water purged, etc.;

2. Copies of all laboratory analytical report(s);

3. Cumulative data tables containing the water quality analytical results and depth to groundwater;

4. An evaluation of the performance of the bioremediation pilot study including an analysis of its effectiveness in destroying the pollutants, and a discussion of the potential for field scale application;

5. A discussion of compliance and the corrective action taken, if any, as well as any planned or proposed actions needed to bring the discharge into full compliance with the waste discharge requirements; and

6. A discussion of any data gaps, potential deficiencies/redundancies in the monitoring system or reporting program and the anticipated date for an effectiveness evaluation of the pilot study.

A letter transmitting the self-monitoring reports shall accompany each report. Such a letter shall include a discussion of requirement violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence will be satisfactory. The transmittal letter shall contain the penalty of perjury statement by the

Discharger, or the Discharger's authorized agent, as described in the Standard Provisions General Reporting Requirements Section B.3.

The Discharger shall implement the above monitoring program as of the date of the Order.

Ordered by: _____
THOMAS R. PINKOS, Executive Officer

RRR

INFORMATION SHEET

ORDER NO. R5-2004-XXX
UNITED STATES AIR FORCE
BEALE AIR FORCE BASE
SITE 10
ENHANCED BIOREMEDIATION PILOT STUDY
YUBA COUNTY

The United States Air Force (Air Force) operates Beale Air Force Base located in Yuba County approximately 40 miles north of Sacramento and 10 miles east of Marysville. Site 10, the location of the enhanced bioremediation pilot study (EISB) is located in the north-central portion of Beale AFB, east of Doolittle Drive and the Flight line Area. Site 10 was used for testing of jet engines from SR-71 aircraft during the period from 1959 and 1990. Two 10,000-gallon aboveground storage tanks (AST) contained JP-7 jet fuel used for engine test runs. Solvents and other cleaning agents were stored in 55-gallon drums on a metal rack near the test stand. Fuel that spilled from engine testing flowed on to the surrounding ground surface and a drainage ditch. Contaminants of concern (COCs) identified in soil and groundwater during the Feasibility Study (FS) include volatile organic compounds (VOCs) and Total Petroleum Hydrocarbons, Diesel Range (TPH-D). The majority of groundwater contamination is the upper aquifer, which extends from approximately 20 to 40 feet below ground surface

The Air Force proposes to conduct a pilot test to evaluate whether sodium lactate has the ability to enhance reductive dechlorination of VOCs in the upper groundwater zone by native microorganisms and the potential for bioaugmentation using a dehalorespiring microbial consortium (KB-1 ^{TM}) to accelerate the rate and extent of biodegradation of VOCs.

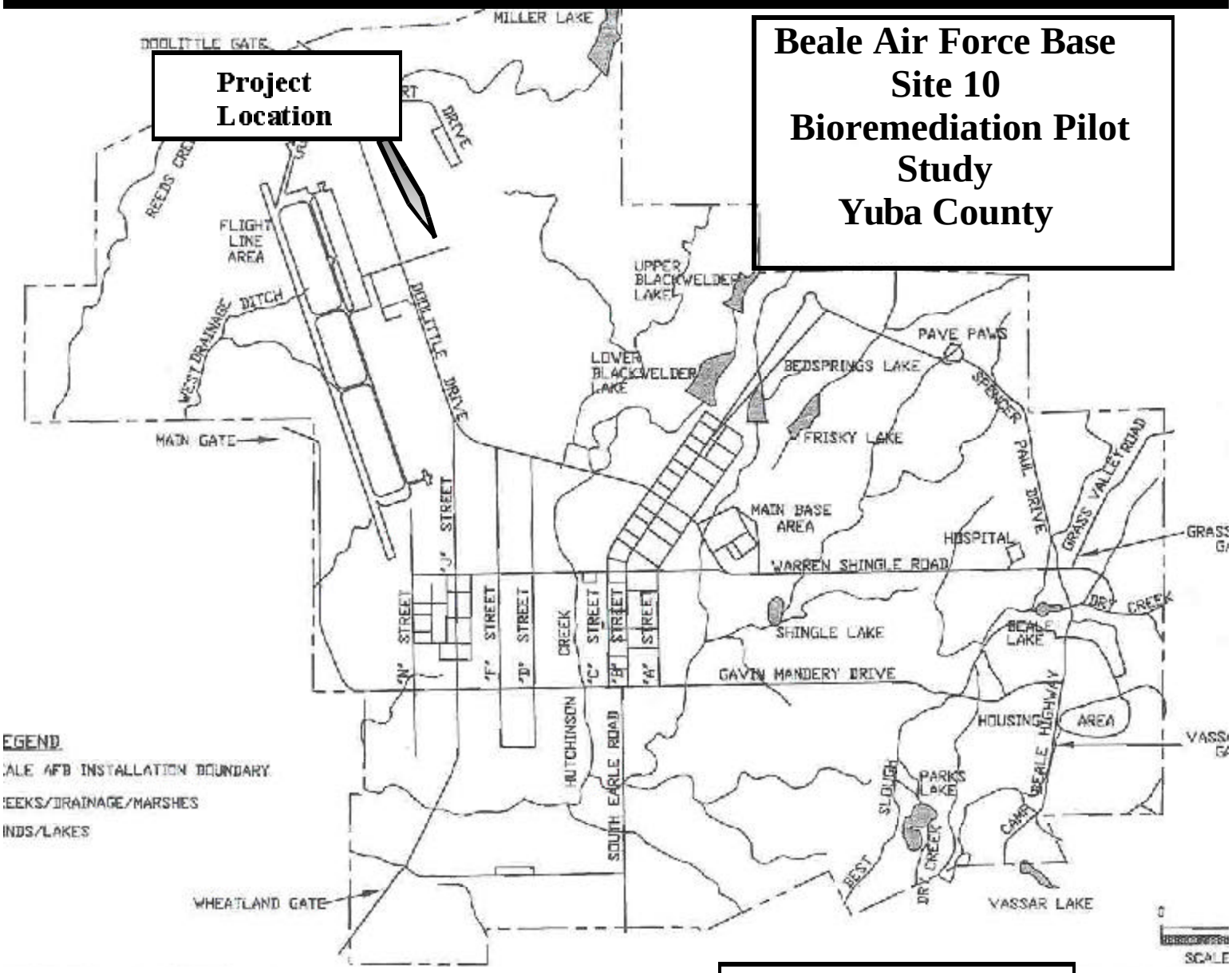
The pilot test approach will include active recirculation of groundwater. Groundwater in the pilot test area contains the following VOCs: PCE (43 µg/l), TCE (1310 µg/l) and cis-1,2 DCE (2020 µg/l). The recirculation system will include extracting groundwater from one well, amending the groundwater with electron donor (lactate) and dehalorespiring bacteria, and reinjecting the amended water to the aquifer. Two monitoring wells installed between the extraction and injection well (spaced 36 feet apart) will be utilized to estimate biodegradation rates within the recirculation system. Performance will be assessed over a 4-month period by monitoring the decline in VOC concentrations coupled with the production of ethene and chloride in the recirculating groundwater and the monitoring wells. The data will be used to estimate biodegradation rates and the effectiveness of the EISB technology for the site.

Beale Air Force Base proposes injection of sodium lactate twice over a four-week period followed by a single injection of the KB-1™ dehalorespiring microbial culture. Additional injection of sodium lactate will occur every other day to reduce the potential for biofouling of the injection well. Groundwater samples from three monitoring wells and one extraction well will be collected weekly the first four weeks during initial injection of sodium lactate, monthly after injection of the KB-1™ dehalorespring microbial culture for 4 four months and, followed by quarterly the following year to evaluate the effectiveness of the pilot study.

As part of the monitoring, baseline levels will be determined for monitoring wells downgradient and within the pilot test area. If concentrations of TCE increase above the baseline levels in extraction well 10C024EW, Beale Air Force Base will collect a confirmation sample within seven days of receiving results of the exceedance. Beale Air Force will implement containment measures for VOCs migrating outside the pilot test area, if it is confirmed that the EISB system is not providing adequate treatment of VOCs.

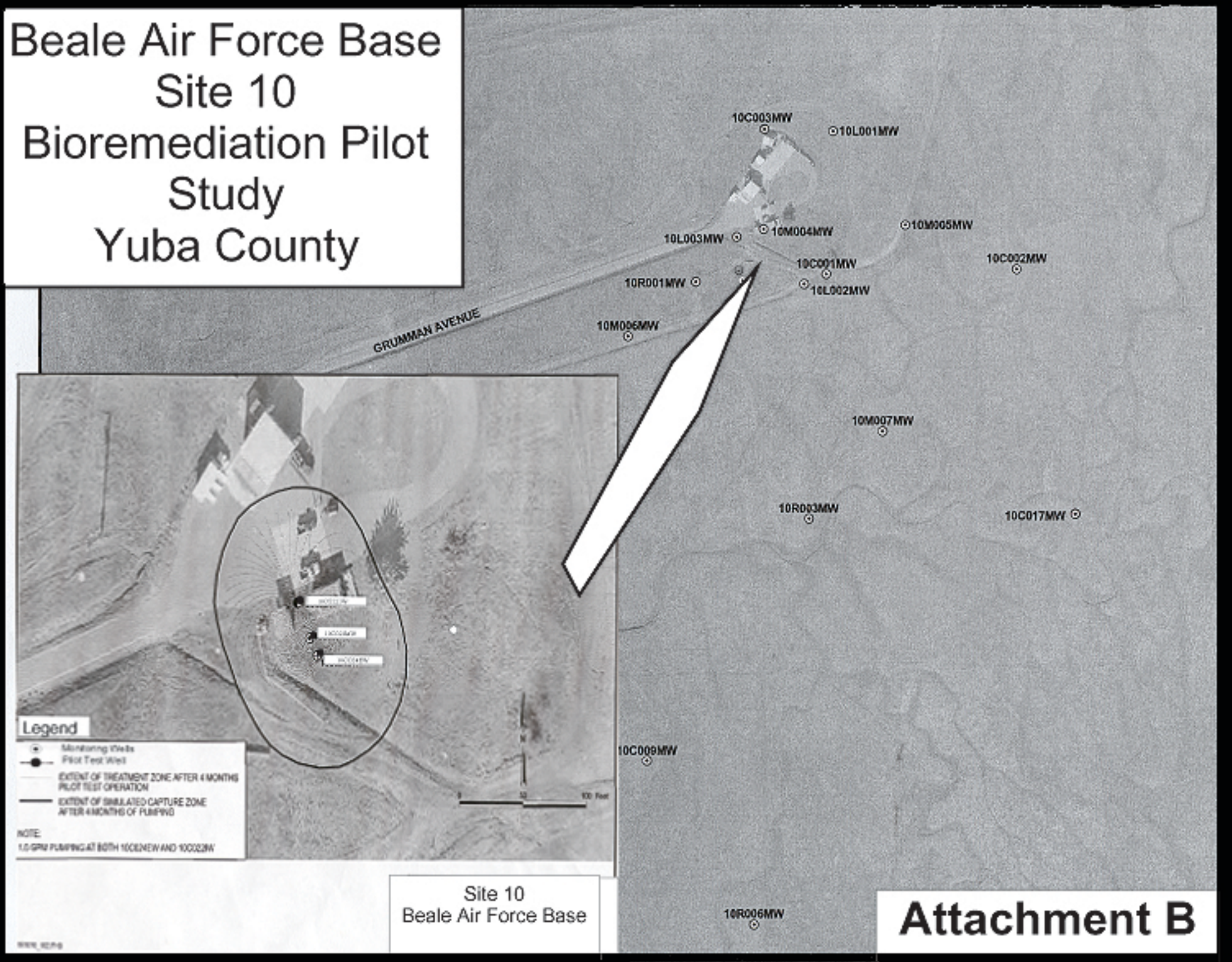
RRR

Beale Air Force Base
Site 10
Bioremediation Pilot Study
Yuba County



Attachment A

Beale Air Force Base
Site 10
Bioremediation Pilot Study
Yuba County



Site 10
Beale Air Force Base

Attachment B